

इंटरनेट

मानक

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“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 11958-1 (1987): Test chart for boring and milling machines with horizontal spindle, Part 1: Table type machines [PGD 3: Machine Tools]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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*Indian Standard***TEST CHART FOR BORING AND
MILLING MACHINES WITH HORIZONTAL SPINDLE****PART 1 TABLE TYPE MACHINES**

1. Scope — Describes both geometrical and practical tests on Table type boring and milling machines with horizontal spindle and the corresponding permissible deviations with reference to IS : 2063-1962 'Code for testing machine tools'.

1.1 It deals only with the verification of accuracy and applies neither to the testing of running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc) nor to the machine characteristics (speeds, feeds, etc) which shall generally be checked before testing the accuracy.

1.2 It also includes complementary geometrical and practical tests in respect of rotary table machines.

Note — It should be noted that this standard concerns machines which have both longitudinal and transverse movement of the table, and may include a rotary or indexing table. It will also have a vertical movement of the spindle head, and possibly a facing head.

2. Preliminary Remarks

2.1 To apply these tests, reference shall be made to IS : 2063-1962 especially for installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

2.2 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and does not define the practical order of testing. In order to make checking or mounting of instruments easier, tests may be carried out in any convenient sequence.

2.3 When inspecting a machine, it is necessary to carry out all the tests described in this standard, excepting those tests which may be omitted in mutual agreement between the buyer and the manufacturer.

2.4 When establishing the tolerance for a measuring range different from that indicated in this standard (see 2.3.1.1 of IS : 2063-1962), it shall be taken into consideration that the minimum tolerance is 0.0025 mm.

2.5 Whenever alternate methods of testing are suggested, the choice of actual method of testing is left to the manufacturer.

2.6 For the purpose of this standard, various methods of expressing permissible deviation are employed, each having a particular type of application. The methods employed are as follows:

000/000 for deviations of perpendicularity which are ratios.

000 for any length of 000 for deviations of straightness and parallelism; this expression is used in fact for local permissible deviations, the measuring length being obligatory.

000 for 000 for deviations of straightness and parallelism; this expression is used to recommend a measuring length but in this case the proportionality rule comes into operation if the measuring length differs from those indicated.

3. Testing Instruments — The testing instruments shall be of the approved type and shall be calibrated at a recognized temperature conforming to the relevant Indian Standards.

4. Accuracy Requirements — The tests to be carried out, the instruments required, the maximum permissible deviations and the manner of carrying out the tests shall be as detailed in the test chart.

Adopted 13 February 1987

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TEST CHART FOR BORING AND MILLING MACHINES WITH HORIZONTAL SPINDLE — TABLE TYPE MACHINES

TYPE.....
MACHINE NO.

ORDER NO.

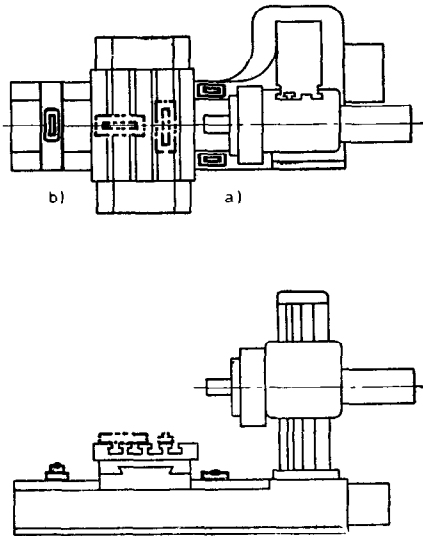
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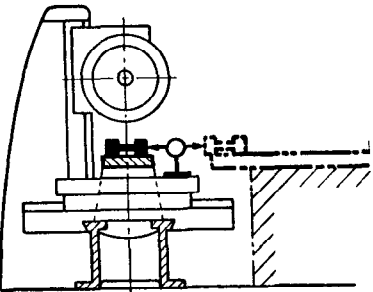
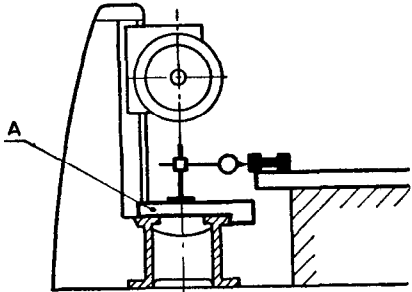
CUSTOMER.....
INSPECTOR.....

I GEOMETRICAL TESTS

All dimensions in millimetres.

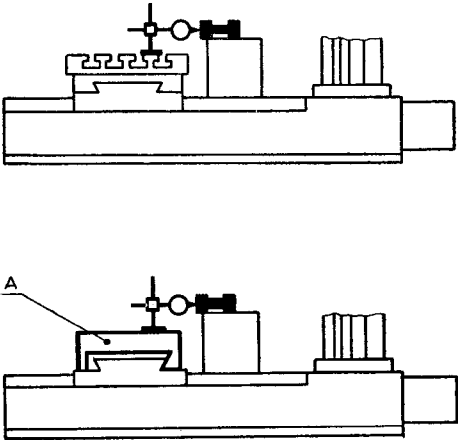
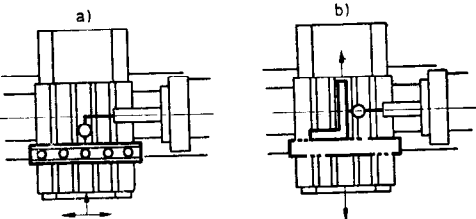
A — BED

SI No.	Figure	Object	Measuring Instruments	Reference to Clauses of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.		<p>Verification of levelling of slide-ways:</p> <p>a) Longitudinal verification: straightness of slideways in the vertical plane</p>	Precision level optical or other methods	<p>3.3 and 3.2.1</p> <p>Measurements shall be made at a number of positions equally spaced along the length of the bed</p> <p>1) The table shall be placed in the middle of its longitudinal travel and transverse travel</p> <p>2) The table shall then be placed at the extreme ends of the longitudinal travel and in the middle of the transverse travel</p> <p>The level may be placed on the table</p>	<p>a) 0.02 up to 1 000 (flat to convex)</p> <p>Local tolerance:</p> <p>0.006 over any measuring length of 300</p> <p>For each 1 000 increase in length add to the corresponding preceding tolerance 0.01</p> <p>Maximum permissible deviations 0.05</p>	

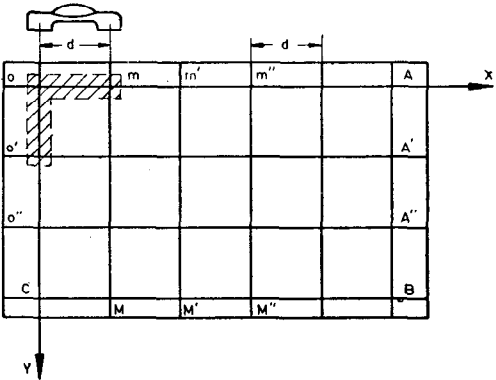
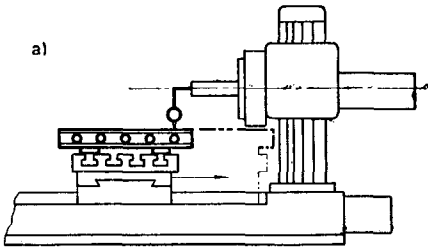
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		b) Transverse verification: slideways should be in the same plane	Precision level and support	<p>5.3.1.2 (g)</p> <p>A level shall be placed transversely and measurements taken at a number of positions equally spaced along the length of the bed. The variation of level measured at any position shall not exceed the permissible deviation</p> <p>The level may be placed on the table</p>	<p>Variation of level:</p> <p>0·02/1 000</p>	
3		Straightness of the slideways in a horizontal plane	Dial gauge, straight edge and supports or optical methods	<p>5.1.3.2 (a)</p> <p>The dial gauge shall be fixed on a support A of a suitable form such that it can slide in the slideways with the stylus touching, in the horizontal plane, a straight-edge laid parallel to the slideways</p> <p>The straightedge shall be placed on a fixed part, independent or integral with the machine and as near as possible to the slideways to be checked</p>	<p>0·02 up to 1 000</p> <p>Local tolerance:</p> <p>0·006 over any measuring length of 300</p> <p>For each 1 000 increase in length, add to the corresponding preceding tolerance:</p> <p>0·01</p> <p>Maximum permissible deviation:</p> <p>0·05</p>	
2.						

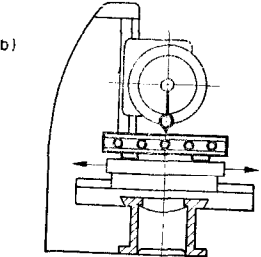
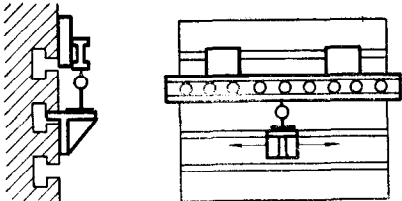
B — TABLE SADDLE

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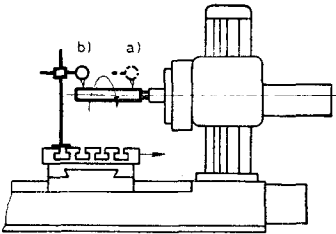
(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.		<p>Straightness of the slideways of the table base or table in the horizontal plane</p>	<p>Dial gauge, straightedge, supports or optical methods</p>	<p>5.1.3.2(a)</p> <p>The dial gauge shall be fixed on a support <i>A</i> of a suitable form such that it can slide in the slideways with stylus touching, in the horizontal plane, a straightedge laid parallel to the slideways</p> <p>The straightedge shall be placed on a fixed part independent, or integral with the machine and as near as possible to the slideways to be checked</p>	<p>0·02 up to 1 000</p> <p>Local tolerance: 0·006 over any measuring length of 300</p> <p>For each 1 000 increase in length, add to the corresponding preceding tolerance 0·01</p> <p>Maximum permissible deviation 0·05</p>	
5.		<p>Squareness of the longitudinal movement of the table to its transverse movement</p>	<p>Dial gauge, straightedge and square</p>	<p>5.4.2.4</p> <p>a) The straightedge shall be set parallel to the table longitudinal movement; then the square shall be placed against the straightedge. The table shall then be locked in the central position</p> <p>b) The transverse movement of the table shall then be checked</p> <p>If the spindle can be locked, then the dial gauge may be mounted on it. If the spindle cannot be locked the dial gauge shall be placed on a fixed part of the machine</p>	<p>0·04/1 000</p>	

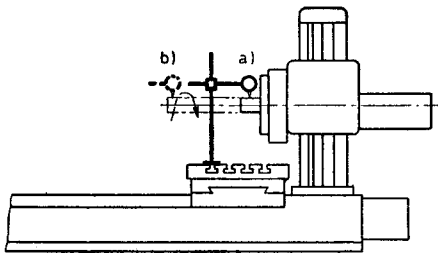
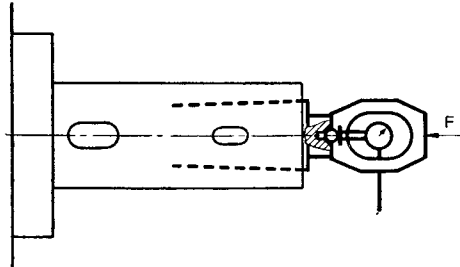
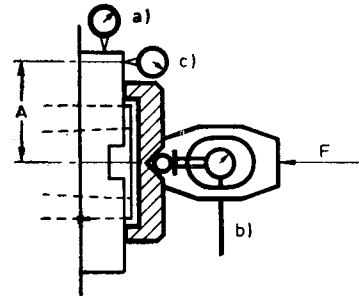
C — TABLE

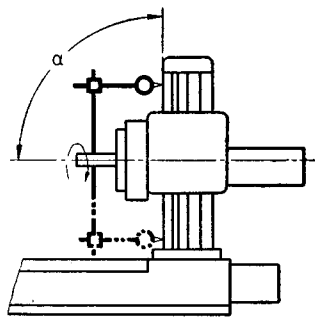
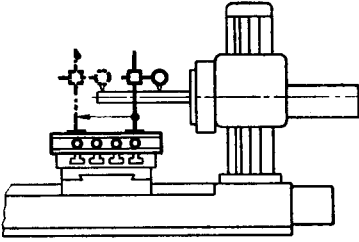
SI No.	Figure	Object	Measuring Instruments	Reference to Clauses of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.		Flatness of table surface	Precision level or straight-edge and gauge blocks	5.2.2.2 and 5.2.2.3 Table not locked in its mid-position and possibly table saddle and table base locked in the middle of their travel	0.03 up to 1 000 (flat to concave) Local tolerance: 0.02 over any measuring length of 300 For each 1 000 increase in length, add to the corresponding preceding tolerance 0.01 Maximum permissible deviation 0.05	
7.		Parallelism of the table surface to its movements: a) Longitudinally	Straightedge and dial gauge	5.1.3.2(a) and 5.3.2.2(a)(1) The stylus of the dial gauge shall be placed approximately in a vertical plane coaxial with the spindle axis Measurement may be made on a straightedge laid parallel to the table surface. If the table length is greater than 1 600, carry out the inspection by successive movements of the straight-edge If the spindle can be locked, the dial gauge may be mounted on it. If the spindle can not be locked, the dial gauge shall be placed on a fixed part of the machine	a) 0.04 up to 1 000 Local tolerance: 0.015 over any measuring length of 300 For each 1 000 increase in length add to the preceding tolerance: 0.01 Maximum permissible deviation 0.06	

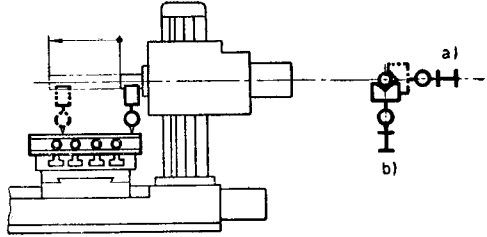
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	 <p>b)</p>	b) Transversely		<p>a) Carry out the test with the transverse movement locked for the table</p> <p>b) Carry out the test with the longitudinal movement locked for the table</p>	b) 0.04 over any measuring length of 1 000	
8		Straightness of the median or reference T slot of the table	Straightedge and dial gauge, or gauge blocks, or microscope and taut wire	<p>5.1.1.2, 5.1.1.2(a), 5.1.1.2(c) or 5.1.3.2</p> <p>The straightedge may be set directly on the table</p>	<p>0.02 for any measuring length of 1 000</p> <p>Maximum permissible deviation 0.03</p>	

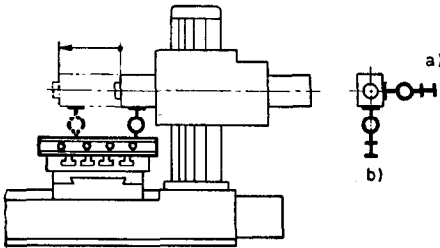
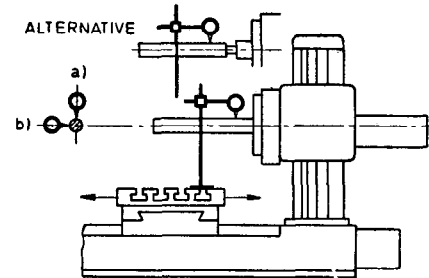
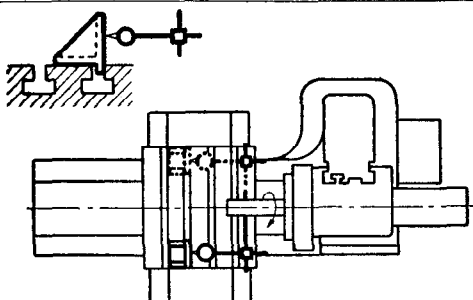
D — SPINDLE HEAD

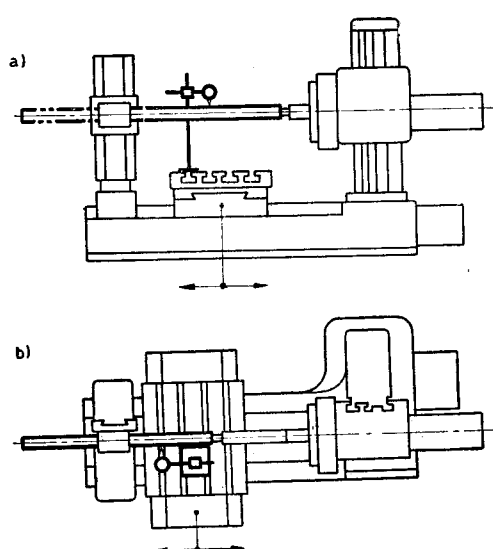
9.	 <p>a)</p> <p>b)</p>	<p>Run out of the internal taper of the boring spindle;</p> <p>a) At the mouth of the taper</p> <p>b) At a distance of 300 from the spindle nose</p>	Dial gauge and test mandrel	<p>5.5.1.2(b)</p> <p>Take measurements with the spindle retracted (sliding spindle)</p>	<p>For $D^* \leq 125$</p> <p>a) 0.01</p> <p>b) 0.02</p> <p>For $D^* > 125$</p> <p>a) 0.015</p> <p>b) 0.03</p> <p>D^* = Diameter of boring spindle</p>	
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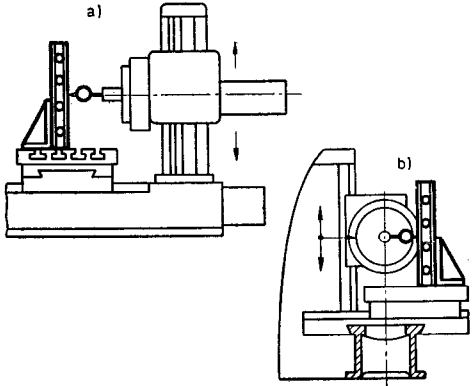
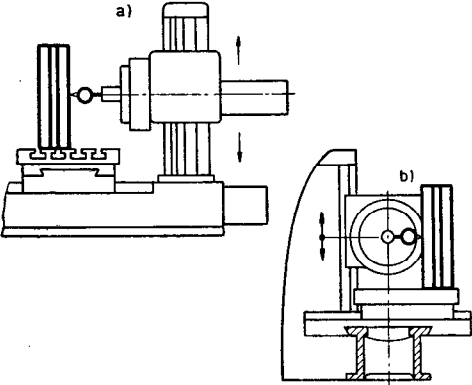
SI No.	Figure	Object	Measuring Instruments	Reference to Clauses of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10.		Runout of the boring spindle a) Spindle retracted b) Spindle out 300 (sliding spindle)	Dial gauge	5.5.1.2(a)	$D^* \leq 125$ a) 0.01 b) 0.02 $D^* > 125$ a) 0.015 b) 0.03	
11.		Periodic axial slip of the boring spindle	Dial gauge	5.5.2.2 and 5.5.2.2(a) Carry out this test with the spindle retracted (sliding spindle) The existence, value and direction of application of the force F shall be stated by the manufacturer	$D^* \leq 125$ 0.010 $D^* > 125$ 0.015	
12.		a) Run out of the milling spindle b) Periodic axial slip c) Camming of the face of the spindle nose (including periodic axial slip)	Dial gauge	a) 5.5.1.2(a) b) 5.5.2.2 and 5.5.2.2(a) The existence, value and direction of application of the force F shall be specified by the manufacturer c) 5.5.3.2 The distance A of dial gauge C from the spindle axis shall be as large as possible Note -- This test is for machine without facing head fitted on it	$D^* \leq 125$ a) 0.01 b) 0.01 c) 0.02 $D^* > 125$ a) 0.015 b) 0.015 c) 0.030 $D^* = \text{Diameter of milling spindle}$	

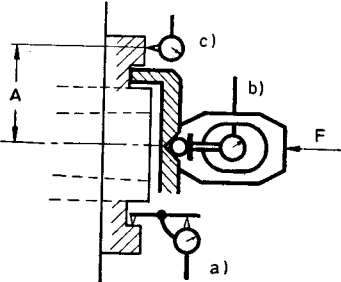
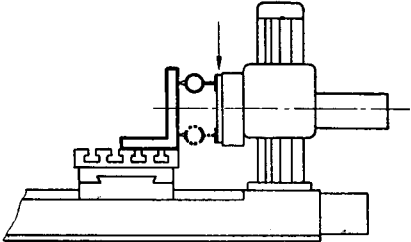
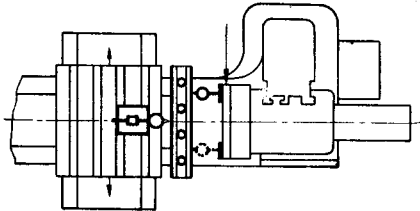
(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.		<p>Squareness of the boring spindle axis to the column ways</p>	<p>Dial gauge</p>	<p>5.4.1.1, 5.4.1.1(b)(3ii) and 5.3.4.2</p> <p>Spindle head locked in mid-travel, spindle retracted (sliding spindle)</p> <p>For large machines for which sizes have a great importance the measuring reference shall be related to a plane parallel to the column ways</p>	<p>0.03/1 000* with $\alpha \leq 90^\circ$</p> <p>*Distance between the two points touched</p>	
14.		<p>Parallelism of the boring spindle axis to the table surface in the vertical plane</p>	<p>Dial gauge</p>	<p>5.3.1.2(d)</p> <p>Spindle head locked in mid-travel, table and table saddle locked. Spindle extended (sliding spindle)</p>	<p>0.02 over a measuring length of 300</p>	

SI No.	Figure	Object	Measuring Instruments	Reference to Clauses of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
15.		<p>Straightness of the boring spindle movement (sliding spindle)</p> <p>a) In a horizontal plane</p> <p>b) In a vertical plane</p>	Straightedge and dial gauge	<p>5.1.3.2(a)</p> <p>Spindle head locked</p> <p>The straightedge shall be set parallel to the sliding spindle movement; then the stylus of a dial gauge fixed on the spindle nose should touch the functional surface of the straightedge. Same operations shall be repeated in the two planes; horizontal and vertical</p> <p>It should be noted that for (b) the permissible deviation involves the normal deflection of the spindle</p> <p>In the case of a machine having a ram, it shall be maintained locked, in the retracted position</p>	<p>a) 0.02</p> <p>For a measuring length of 300</p> <p>b) 0.02</p> <p>For a measuring length of 300</p>	

(1)	(2)	(3)	(4)	(5)	(6)	(7)
16.		<p>Straightness of the sliding ram movement:</p> <p>a) In a horizontal plane</p> <p>b) In a vertical plane</p>	<p>Straightedge and dial gauge</p>	<p>5.1.3.2(a)</p> <p>Spindle head locked</p> <p>Boring spindle retracted</p> <p>The straightedge shall be set parallel to the ram movement. Then touch the functional surface of the straightedge with a dial gauge fixed at the end of the ram</p> <p>The same operations shall be repeated in two planes; horizontal and vertical</p>	<p>a) 0.02</p> <p>For a measuring length of 500</p> <p>b) 0.02</p> <p>For a measuring length of 500</p>	
17.	<p>ALTERNATIVE</p> 	<p>Parallelism of the boring spindle axis to the table movement:</p> <p>a) In a vertical plane</p> <p>b) In a horizontal plane</p>	<p>Dial gauge and test mandrel</p>	<p>5.3.1.2(a) and 5.3.2.2(b)</p> <p>Spindle head locked in mid-travel</p> <p>Table and table base locked in central position, if possible</p> <p>The measurement shall be carried out either directly on the spindle or with the aid of a test mandrel mounted in the spindle nose</p>	<p>a) 0.03</p> <p>For a measuring length of 500</p> <p>b) 0.03</p> <p>For a measuring length of 500</p>	
18.		<p>Squareness of the boring spindle axis to the median or reference T-slot of the table</p>	<p>Dial gauge</p>	<p>5.4.1.1 and 5.4.1.1(b) (4ii)</p> <p>Spindle head locked in mid-travel. Table saddle and table base locked in central position, if possible</p>	<p>0.03/1 000*</p> <p>*Distance between the two points touched</p>	

SI No.	Figure	Object	Measuring Instruments	Reference to Clauses of IS : 2063-1962 and or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
19.	 <p>a)</p> <p>b)</p>	<p>Coincidence of the steady block bore with the boring spindle axis:</p> <p>a) In the vertical plane</p> <p>b) In the horizontal plane</p>	Dial gauge and boring bar or test mandrel	<p>This test does not conform to the test code</p> <p>Due to great distance between supports, a cylindrical bar or a test mandrel shall be used of sufficient length to pass completely through the steady block while mounted in the boring spindle when in its retracted position</p> <p>A dial gauge shall be set on the table with the stylus touching the test mandrel and the table moved over its entire traverse</p> <p>Repeat the same operations with the spindle extended</p> <p>Test (a) shall be carried out setting the spindle head and the steady block first in high position, then in low position, or vice versa</p> <p>Test (b) shall be carried out with the spindle head and steady block locked in mid-travel. Table and table base locked in central position</p> <p>In the case of large machines, it may be desirable to use in place of a single mandrel two short test mandrels, placed in the spindle nose and in the steady block bore</p>	<p>a) 0.4 for a measuring length of 1 000</p> <p>b) 0.03 for a measuring length of 1 000</p>	

(1)	(2)	(3)	(4)	(5)	(6)	(7)
20.		<p>Straightness of the vertical movement of the spindle head:</p> <p>a) In the vertical plane coaxial with the spindle axis</p> <p>b) In the vertical plane perpendicular to the spindle axis</p>	<p>Dial gauge, straightedge or square</p>	<p>5.1.3.2(a)</p> <p>The test shall be carried out with the table saddle locked, the table and table base locked in mid-position, if possible</p> <p>This does not conform to test code. A square may be used instead of a straightedge</p> <p>If the spindle can be locked, the dial gauge can be mounted on it. If the spindle cannot be locked, the dial gauge shall be placed on the spindle head of the machine</p>	<p>a) 0.02 For a measuring length of 500</p> <p>b) 0.02 For a measuring length of 500</p>	
21.		<p>Squareness of the table surface to the vertical movement of the spindle head:</p> <p>a) In the vertical plane coaxial with the spindle axis</p> <p>b) In the plane perpendicular to the spindle axis</p>	<p>Dial gauge and square</p>	<p>5.4.2.2</p> <p>The test shall be carried out with the table saddle and table base locked in mid-position, if possible</p> <p>Lock the spindle head when taking measurement</p> <p>If the spindle can be locked, the dial gauge can be mounted on it. If the spindle cannot be locked, the dial gauge shall be placed on the spindle head of the machine</p>	<p>a) 0.02/500</p> <p>b) 0.02/500</p>	

E — DETACHABLE PLATE						
SI No.	Figure	Object	Measuring Instrument	Reference to Clauses of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
22.		<p>Checking the mounting surfaces of the adaptor plate:</p> <p>a) Run out of the face centering (for internal location only)</p> <p>b) Periodic axial slip</p> <p>c) Camming of the support surface of the adapting plate (including periodic axial slip)</p>	Dial gauge	<p>a) 5.5.1.2(a)</p> <p>b) 5.5.2.2 and 5.5.2.2(a)</p> <p>The existance value and direction of force <i>F</i> shall be specified by the manufacturer</p> <p>c) 5.5.3.2</p> <p>The distance <i>A</i> of dial gauge (c) from the spindle axis shall be as large as possible</p>	<p>a) 0.01</p> <p>b) 0.01</p> <p>c) 0.02</p>	
F — INTEGRAL SURFACING HEAD						
23.		Squareness of the movement of the radial facing slide to the table surface	Dial gauge and square	<p>5.4.2.2</p> <p>Same operation shall be repeated after turning the plate by 180°</p>	0.025/300	
24.		Parallelism of the facing slide movement to the transverse movement of the table	Straightedge and dial gauge	<p>A straightedge laid parallel to the transverse movement of the table shall be placed on the bed</p> <p>The stylus of a dial gauge fixed on the radial facing slide of the surfacing head shall touch the straightedge</p> <p>This test shall be repeated after turning the facing head by 180°</p>	0.025 for measuring length of 300	

TEST CHART FOR BORING AND MILLING MACHINES WITH HORIZONTAL SPINDLE — TABLE TYPE MACHINES

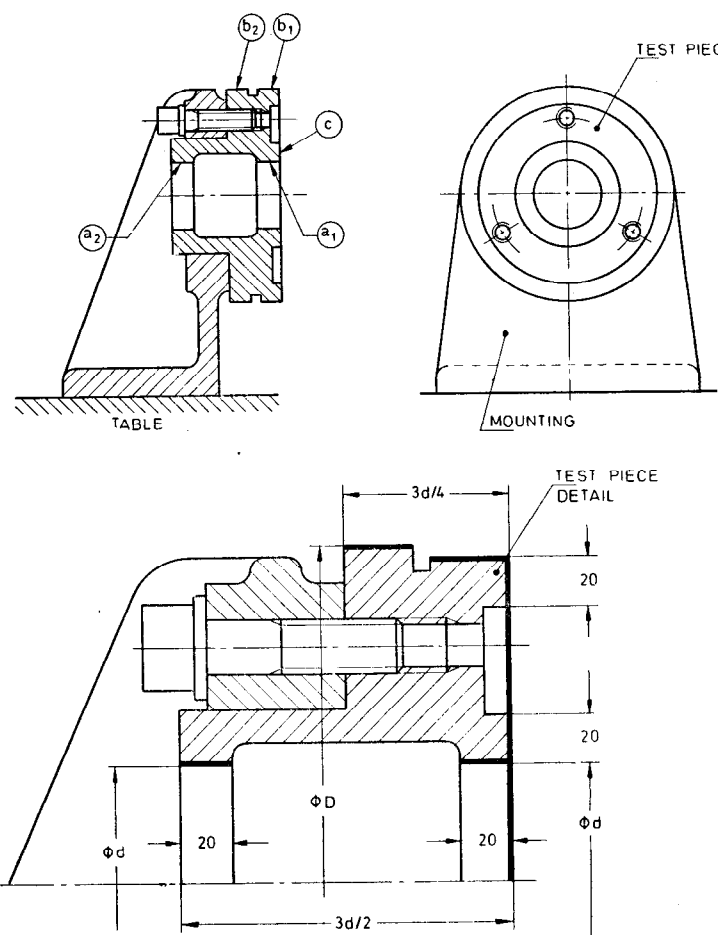
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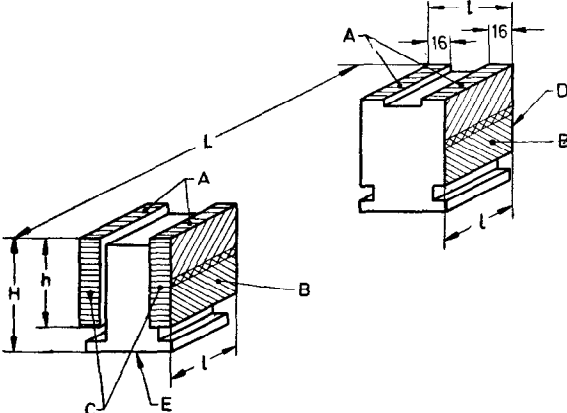
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INSPECTOR.....

II PRACTICAL TESTS

(All dimensions in millimetres)

Diagram, Sizes and Mounting of the Test Piece (Given only as an example)	Nature of Test	Checks to be Applied No.	Designation	Measuring Instru- ments	Reference to IS : 2063- 1962 and/or Instruction for Testing	Permis- sible De- viations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<p>1) BORING, TURNING AND FACING*</p> 	<p>Machining of a single test piece. Boring of the internal cylindrical holes a_1 and a_2. Turning of the external cylindrical surfaces b_1 and b_2. Facing of the surface c</p>	P ₁	<p>CIRCULARITY</p> <p>Of the internal cylindrical holes a_1 and a_2 and of the external cylindrical surface b_1</p>	<p>Bore gauge and micrometer or measuring instruments having the appropriate accuracy</p>	<p>*This test only applies to machines having both a sliding boring spindle and either an integral or detachable facing head, or an independent milling spindle</p>	<p>$d \leq 125$ 0.007 5</p> <p>$d > 125$ 0.010</p>	
		P ₂	<p>CYLINDRICITY</p> <p>Of the internal cylindrical holes a_1 and a_2</p>		<p>3.1, 3.2.2, 4.1, 4.1.1, 4.1.2, 4.1.3, 4.2, 4.2.1, 5.3.4.2, 5.4.1.1(b) 3(ii) and 5.5.1.1(c)</p>	<p>$d \leq 125$ 0.010</p> <p>$d > 125$ 0.015</p>	
		P ₃	<p>CONCENTRICITY</p> <p>Of the internal cylindrical hole a_1 and of the external cylindrical surface b_1</p>	<p>Mandrel and dial gauge</p>	<p>Before commencing the tests it shall be ensured that the mounting surface which bears on the table is flat and that the test piece surface which bears with the mounting is perpendicular to the axis of its housing</p>	<p>0.025</p>	

Diagram, Sizes and Mounting of the Test Piece(Given only as an Example)	Nature of Test	Checks to be Applied		Measuring Instruments	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
		No.	Designation				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Notes: 1. The boring diameter d shall be slightly greater than, or at least equal to, boring spindle diameter 2. The turned diameter D shall be determined so that the value $\frac{D-d}{2}$ is slightly less than, or at most equal to the maximum travel of the radial facing slide 3. Test piece mandrel: cast iron		P_4	COAXIALITY Of the external cylindrical surfaces b_1 and b_2 with the reference axis of the internal cylindrical holes a_1 and a_2	Mandrel and dial gauge	DIRECTION FOR MACHINING 1) Boring and finishing of the two internal cylindrical holes a_1 and a_2 . Table locked and axial movement of the sliding boring spindle	0.04 for a longitudinal movement of the table saddle of 300	
		P_5	FLATNESS Of the machine surface c	Straight-edge and gauge blocks	2) Turning of the external cylindrical surface b_1 with a short tool mounted on the facing head with longitudinal movement of the table saddle	0.015 for a diameter D of 300	
		P_6	PERPENDICULARITY Of the machined face c with the reference axis of the internal cylindrical holes a_1 and a_2	Mandrel and dial gauge or level and special support	3) Longitudinal movement of the table of 300 and turning of the external cylindrical surface b_2 . Tool mounted on the surfacing head, with the aid of a support or a tool holder having a suitable length 4) Machining of the face c by automatic movement of the radial facing slide or by milling	0.025/300	

SI No.	Diagram and Dimensions of Test Pieces	Nature of Test	Cutting Conditions	Checks to be Applied	Measuring Instruments	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
P7	<p>2) MILLING</p> 	Milling of strips of surfaces A, C and D by automatic transverse movement of the table, automatic vertical movement of the spindle head and manual longitudinal movement of the table saddle	With a shell end mill, mounted at the end of the spindle on a mandrel of a suitable length			<p>3.1, 3.2.2, 4.1, 4.1.1, 4.1.2, 4.1.3, 4.2 and 4.2.1</p> <p>Before beginning of the test it shall be ensured that surface E is flat. Test pieces shall be aligned parallel to the direction of the transverse movement of the table so that the length L is equally distributed on either side of the table centre</p> <p>Note — Subject to agreement between the user and the manufacturer, the form of test piece shown in the diagram may be replaced by a simpler form of test piece having sides of full width, in which case the test carried out using this form shall be at least as severe as the one carried out using the form in the diagram</p>		

Sl No.	Diagram and Dimensions of Test Pieces	Nature of Test	Cutting Conditions	Checks to be Applied	Measuring Instruments	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<p>L (length of the test piece or distance between the opposite faces of two test pieces) = $\frac{1}{2}$ transverse travel of the table</p> <p>$l = h = 1/8$ transverse travel of the table</p> <p>$l \text{ max} = 100$ for $L \leq 500$ $= 150$ for $500 < L \leq 1\,000$ $= 200$ for $L > 1\,000$</p> <p>$l \text{ min} = 50$</p> <p>Note 1 — Transverse travel for the table > 400: one or two test pieces can be used and they shall be machined in the longitudinal direction over a length l at each end</p> <p>Note 2 — Transverse travel for the table < 400: one test piece is used and it shall be machined over its entire length</p> <p>Note 3 — Material: Cast Iron</p>	Milling of surface B by automatic transverse movement and manual vertical movement of the spindle head at least in two cuts overlapping by about 5 to 10	Slab milling with the same cutter	<p>Surface B on each block shall be flat</p> <p>a) The planes containing the strips of surfaces C, A and D shall be perpendicular to each other and each one perpendicular to the surface B</p> <p>b) The height H of the block (or blocks) shall be constant</p>	<p>Straight-edge and gauge blocks or Micro-meter callipers, square and gauge blocks</p> <p>Micrometer</p>	<p>The cutter shall be sharpened on its arbor and when mounted shall conform to the following tolerances:</p> <p>1) Out of round* ≤ 0.01</p> <p>2) Run out ≤ 0.02</p> <p>3) Camming ≤ 0.03</p> <p>All non-operating slides shall be locked during cutting</p> <p>*See IS : 8000 (Part 1) - 1976</p>	<p>0.02</p> <p>0.02/100</p> <p>0.03</p>	

TEST CHART FOR BORING AND MILLING MACHINES WITH HORIZONTAL SPINDLE — TABLE TYPE MACHINES
COMPLEMENTARY TESTS IN THE CASE OF ROTARY TABLE MACHINES

(Clause 1.2)

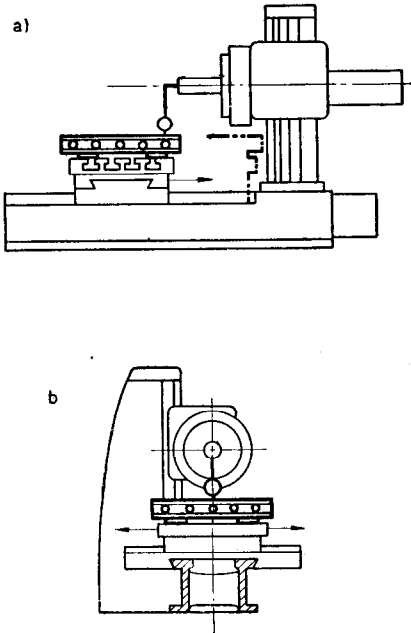
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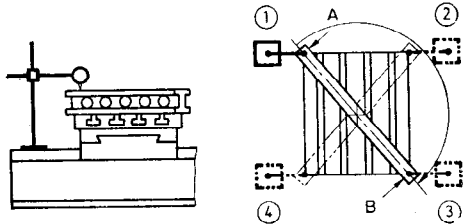
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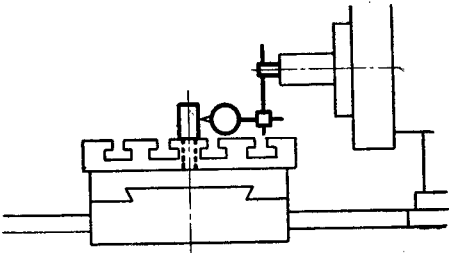
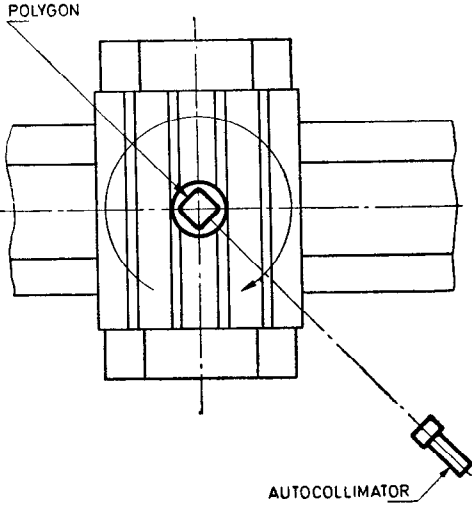
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INSPECTOR

III GEOMETRICAL TESTS (COMPLEMENTARY)

(All dimensions in millimetres)

SI No.	Figure	Object	Measuring Instruments	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.		Parallelism of the table surface to its movements: a) Longitudinally	Straightedge and dial gauge or optical methods	<p>5.1.3.2(a) and 5.3.2.2(a)</p> <p>The stylus of the dial gauge shall be placed approximately in a vertical plane passing through the spindle axis</p> <p>Measurement may be made on a straightedge laid parallel to the table surface. If the table length is greater than 1 600, carry out the inspection by successive movements of the straightedge</p> <p>If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked, the dial gauge shall be placed on a fixed part of the machine</p> <p>a) Carry out the test with the transverse movement of the table locked</p> <p>b) Carry out the test with the longitudinal movement of the table locked</p> <p>The parallelism shall be measured at each of the following indexed positions of the rotating table: 0°, 90°, 180° and 270°</p>	<p>a) 0·04 up to 1 000 Local tolerance: 0·015 over any measuring length of: 300</p> <p>For each 1 000 increase in length add to the preceding tolerance 0·01</p> <p>Maximum permissible deviation: 0·06</p> <p>b) 0·04 over any measuring length of 1 000</p>	

SI No.	Figure	Object	Measuring Instruments	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.		Measurement of camming of the table surface in its rotating movement	Straightedge and dial gauge	<p>5.5.3.2, 5.5.3.2(a), 5.5.3.2(b) and 5.5.3.3</p> <p>1. The dial gauge being placed in position 1, the straightedge shall be placed in a vertical plane passing through the rotation axis of the table and the parts farthest from the rotation centre</p> <p>Take a measurement at point A. Rotate the table through 180° and then take measurement at B</p> <p>Carry out the same operations putting the straightedge in another vertical plane perpendicular to the preceding one</p> <p>Note—The maximum deviation of these four readings</p> <p>2. Repeat the same process placing the dial gauge in successive positions 2, 3 and 4</p> <p>For each of these positions note the deviation between maximum and minimum readings</p> <p>Use the greatest of these deviations as the value of camming</p> <p>Lock the table before taking measurements</p>	0.02 over a measuring diameter of 1 000	

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.		Run out of the internal centring of the table in relation to its axis of rotation	Dial gauge and test mandrel	<p>5.5.1.2(b)</p> <p>If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked, then the dial gauge shall be placed on a fixed part of the machine</p> <p>Set the stylus of the dial gauge co-axial with the mandrel axis and as near as possible to the table surface</p> <p>Checking may also be carried out by direct measurement on the bore</p>	0.015	
4.		<p>Accuracy of the table indexing and of repeatability of the angular positioning</p> <p>a) For rotary tables with only four indexing position 90° apart (without rotary milling capability)</p> <p>b) For rotary tables with any number of fixed indexing position (without rotary milling capability)</p>	Autocollimator and polygon	<p>6.4.1, 6.4.2, 6.4.2.1, and 6.4.3</p> <p>A polygon shall be set and fixed approximately in the table centre</p> <p>Adjust the alignment of an autocollimator with the polygon for any given indexing position of the rotary table</p> <p>Rotate the table one complete revolution. Then index and lock, and note the deviation observed. Repeat the operation several times</p> <p>The table shall then be indexed to the following angular position</p> <p>Similarly but without modifying the autocollimator setting, the deviation shall be measured before and after one complete table revolution</p>	<p>a) Plus and minus 6 seconds of arc or maximum width of tolerance band of 12 seconds of arc</p> <p>b) Plus and minus 10 seconds of arc or maximum width of tolerance band of 20 seconds of arc</p>	

SI No.	Figure	Object	Measuring Instrument	Reference to IS : 2063-1982 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		c) For rotary tables with automatic positioning for indexing and rotation (with rotary milling capability)		<p>The same checks shall be carried out for every indexing position of the table. Lock the table before taking measurements</p> <p>Note — If the table is provided with an indexing device valid for the two directions of rotation, the same checks shall be carried out rotating the table in one direction and in the other direction</p>	c) Plus and minus 15 seconds of arc or maximum width of tolerance band of 30 seconds of arc	

TEST CHART FOR BORING AND MILLING MACHINES WITH HORIZONTAL SPINDLE — TABLE TYPE MACHINES (COMPLEMENTARY TESTS IN THE CASE OF ROTARY TABLE MACHINES)

(Clause 1.2)

TYPE.....

ORDER NO.

CUSTOMER

MACHINE NO.

DATE

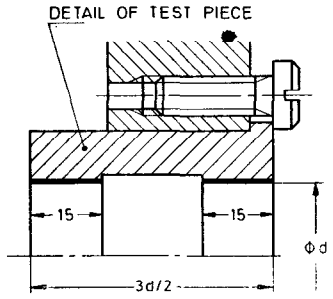
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IV PRACTICAL TEST (COMPLEMENTARY)

(All dimensions in millimetres)

23

Figure	Nature of Test	Checks to be Applied	Measuring Instruments	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Boring and finishing of two test pieces mounted opposite each other on a single axis parallel with the surface and in a vertical plane coaxial with the centre of rotation of table	Checking of the equidistance of the axes of the bores d_1 and d_2 in relation to a vertical plane through R_1 , R_2 and R_3 (the distances l_1 and l_2 equivalent)	Test mandrel and dial gauge and gauge blocks	<p>3.1, 3.2.2, 4.1, 4.1.1, 4.1.2, 4.1.3, 4.2, 4.2.1, and 5.3.2.2</p> <p>For performing this test it is not necessary to dismantle the test pieces from the fixture (or support). The fixture with the test pieces mounted in it can be laid on a surface plate</p> <p>Before commencing the test make sure that the fixture surface which bear on the table is flat and that the bore axes intended for supporting the test pieces and the axis of centring C are equidistant from a vertical reference plane defined by the three blocks, R_1, R_2 and R_3</p>	<p>The values of permissible deviation given below correspond to the three types of tables described in complementary geometrical test SI No. 4</p> <p>a) 0.06 for a length L equal to: 1 000</p> <p>b) 0.10 For a length L equal to: 1 000</p>	

Figure	Nature of Test	Checks to be Applied	Measuring Instrument	Reference to IS : 2063-1962 and/or Instruction for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
<div><p>Note 1 — The fixture length L shall be slightly less than, or at most equal to the table width</p><p>Note 2 — The bore diameters d_1 and d_2 shall be approximately equal to half the boring spindle diameter</p><p>Note 3 — Test piece material: Cast Iron</p></div>				<p>PROCEDURE</p> <p>Before lying the fixture on the table, make sure that the axis of rotation of the table is situated exactly in the vertical plane through the boring spindle axis, then lock the table base in its slide-ways</p> <p>Arrange the mounting on the table so that its centring C coincides exactly with the axis of rotation of the table possibly using a centring mandrel M</p> <p>Swivel the mounting on the table, setting the reference block R_1 and R_2 in a vertical plane through the boring spindle axis</p> <p>Lock the mounting on the table and assemble the test pieces as shown on the diagram</p> <p>Finish boring to the diameter d of the first test pieces with axial movement of the boring spindle</p> <p>Rotate the table by 180° and bore the second test piece similarly</p> <p>Note — Except for the rotation of the table and the rotation of the boring spindle, all the other parts of the machine shall be locked during this test</p>	c) 0.15 for a length L equal to: 1 000	

EXPLANATORY NOTE

This standard is generally based on ISO 3070/I-1975 'Test conditions for boring and milling machines with horizontal spindle — Testing of accuracy: Part I Table type machines' and addendum 1-1976 'Complementary geometrical tests and practical tests to be specified in the case of rotary table machines' issued by International Organization for Standardization (ISO). However, in case of spindle head, permissible variation values specified for geometrical test SI No. 9, 10, 11, 12 and practical test numbers. P1 and P2 are in the line with corresponding tests as laid down in ISO 3070/II-1978 'Test chart for boring and milling machines with horizontal spindle — Part II — Floor type machines.